STANDARD FORM NO. 64

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Office Memorandum • UNITED STATES GOVERNMENT

TO   : The Files - Contract 605   DATE: 26 June 1959

FROM   25X1

SUBJECT: Trip Report -   25X1

1. On 23 June 1959 [ ] of OC-E/R+D-EP visited   25X1
the [ ] to monitor progress   25X1
on Contract 605, Task Orders 1, 2, 4, 6 and 8.

2. <u>High Gain Inflatable Pouchable Antennas, Task 1</u> - One of these
antennas has been received at Headquarters and was found to be mechani-
cally acceptable. A study of the test data at [ ] showed that the   25X1
antenna met our specifications adequately. Gain of $6\frac{1}{2}$ foot inflatable
dish antenna varies from about 16 db at 350 mcs to 35 db at 6,000 mcs,
while the 2 foot dish antenna showed gains from about 25 db at 6,000
mcs to about 37 db at 10,000 mcs. VSWR for the $6\frac{1}{2}$ foot dish antenna
gernerally stayed below 3:1 with only three 'pop-ups' in the entire
range, each one being very narrow and not exceeding 3.6:1 when com-
pensated for line loss. The 2 foot dish antenna showed VSWR below
2:1 over the range of 6,000 to 10,000 mcs even with the single electro-
magnetic horn feed. Verbal acceptance of the other air inflatable
antennas was made. [ ] delivery schedule now calls for delivery   25X1
of six air inflatable antennas instead of the original five antennas
called for in the contract. The first antenna was to serve as an
expendable prototype, but since it has been found acceptable, all six
antennas will be delivered. [ ] will request an overrun for this   25X1
project, the overrun not being due to the construction of six antennas.
[ ] experienced considerable difficulty in constructing the original   25X1
antenna and used considerable more engineering and model shop time than
their original proposal indicated they would. The amount of the overrun
will be about $8,000 to 10,000 according to [ ]. Past experi-   25X1
ence has shown that the amount of the overrun will probably be con-
siderably more than that quoted verbally by the [ ] engineers.   25X1

3. <u>CS-8/AN-20 Antenna - Task 2</u> - Electrical test data for this
antenna, originally designed to cover the range of 30 to 600 mcs,
shows that the antenna is almost omnidirectional in the range of 30
to 55 mcs. At 30 mcs the VSWR is 3:1. Above this frequency the VSWR
rises rapidly to 17:1 at 47 mcs and then tapers off to the nominal
value of 3:1 at a frequency of about 52 mcs. The instruction book for
this antenna is in publication at the present time and we have been
assured that it will be deliverable not later than the first of July.
Upon delivery of the instruction book for this antenna Task 2 can be
terminated.

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4. <u>Parabolic Reflector and Feeds - Task 4</u> - One of these antennas has been delivered to Headquarters and <u>has been</u> found acceptable mechanic-ally. Examination of the test data at [   ] showed gains from about   25X1
16 db at 600 mcs to 35 db at 6,000 mcs with a VSWR of less than 3:1 over the entire range. Verbal acceptance of the <u>other four</u> antennas was made with delivery expected within 60 days. [   ] has requested   25X1
that acceptance of these antennas be put in writing for their records.

5. <u>30-1,000 mc Log Periodic Antenna - Task 6</u> - [   ] has signed   25X1
the contract for the construction of five of these antennas and has started some model work. A new concept will be used in the construction of this antenna. Basically the new structure will resemble an array of dipoles with their spacing and lengths varied in a logarithmically periodic manner. The feed will consist of a two wire transmission line which criss-crosses between alternate elements so as to provide the necessary phase reversals between adjacent elements. This new design promises to be considerably lighter than conventional log periodic structures and yet it will maintain the high gain and constant beam-width of the other types of log periodic structures.

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relaxed our specifications as to detector sensitivity somewhat, using the original specification figures as a design goal. [   ] stated   25X1
that in addition to the test equipment which is to be supplied as GFE for this task he would also like the loan of two or more video amplifiers of the type which will be used with this system. He will accept the VA-7 as a representative video amplifier. Although he stated that they will not need the test equipment for several months, he was told that, because the equipment was being held for [   ], prompt shipment of   25X1
the equipment would make our job considerably easier. [   ] agreed   25X1
to accept the test equipment within the next two months and keep it in storage until it is actually needed.

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8. Near Field Cancellation of Radiated Fields - A discussion was held with [   ] to discuss the possibility of reducing or eliminating the near field of an antenna system so as to provide signal security against the close-in intercept operater. The following equations are general forms for the radiation field of a small dipole antenna and holds quite well for all types of arrays, being modified by only a multiplier in the case of a directive array.

$$E_\theta = \frac{I\,dl\,\sin\theta}{4\pi\epsilon}\left(\frac{-\omega\,\sin\omega(t-r/v)}{v^2 r} + \frac{\cos\omega(t-r/v)}{r^2 v} + \frac{\sin\omega(t-\frac{r}{v})}{\omega r^3}\right)$$

$$E_r = \frac{2I\,dl\,\cos\theta}{4\pi\epsilon}\left(\frac{\cos\omega(t-\frac{r}{v})}{r^2 v} + \frac{\sin\omega(t-\frac{r}{v})}{\omega r^3}\right)$$

As can be seen from the above equation, all the terms are inter-dependent with θ and r as common factors. Reduction of the terms which vary as r^{-2} and r^{-3} necessitate the reduction of the term which varies as r^{-1} and which produces the far field. Maxwells four basic equations for an electromagnetic field are as follows:

$$\nabla \times H = \dot{D} + \dot{\iota}, \quad \nabla \times E = -\dot{B}, \quad \nabla \cdot D = \rho, \quad \nabla \cdot B = 0$$

If a ring of silence is generated about an antenna system, it can be shown from the four above equations that if the Poynting vector is zero at the ring of silence, it must be zero at all points beyond the ring. Thus cancellation by phase reversal of a second near field is not possible. One possible approach however is to space two antennas of identical characteristics equidistantly and considerably removed from the operator. Theoretically the field directly above and very near the operator will be zero. Although this will not produce security for the system, it might protect the operator. A second approach is to move the frequency of operation to the VHF region so that parabolic antenna systems might be used. There are methods of almost completely cancelling side lobes by using absorbing material around the edge of the parabola and radiation would be in only one direction. This system, when using highly redundant transmissions for tropo-scatter communications, would provide security in beamwidth and should be almost undetectable at low angles. A third possible approach is to place the normal transmitting antenna above ground and a second below ground. The wave radiating from the above ground antenna can be roughly represented by the following expression:

$$E = A_0 \cos\left(\omega\left(t - \frac{r}{v}\right)\right)$$

The wave propagating through the ground would roughly obey the following equation:

$$E = A_0 \cos\left(\omega\left(t - r\sqrt{\mu\epsilon}\right)\right)$$

If the below ground wave is delayed in time an amount equal to degrees, a point equidistant between the antennas should show essentially zero field strength. As the two waves propagate, one through the air and

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the other through the earth, a relative phase rotation will result due to the slower velocity of propagation for the below ground wave. At some point removed from either antennas, the waves would be in phase and it is possible that they would radiate from this area of intersection. There is unfortunately no experimental evidence for this last possibly to test its feasibility.

9. New Type of SHF Antenna: Equiangular Spiral - On page 181 of IRE Transactions, Antennas and Propagation, Volume AP-7, No. 2, John Dyson of the University of Illinois describes a new type of antenna called the equiangular spiral antenna, which will operate satisfactorily to 10,000 mcs. [   ] was questioned about   25X1
the operation of this type of antenna. Gain obtainable with this antenna approximates dipole gain, the pattern is bidirectional, and the polarization is circular. [   ] indicated that they   25X1
would be interested in constructing some of these antennas if we presented it to them in the form of a requirement. [   ]   25X1

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was told that if a requirement for such an antenna arose, we would talk to him more about it. It is understood that [   ]   25X1
is now selling such an antenna commercially. It differs in that the slot structure is two dimentional and is backed up with a cavity containing annular rings perpendicular to the x, y plane of the spiral. These rings provide roughly the same effect as the varying slot depth in [   ] antenna.   25X1

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